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DOCUMENT RESUME

ED 040 956 SP 004 004

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TITLE The Effects of Classification Practice Selection Strategy and Attribute Labeling in Initial Concept Identification and Subsequent Learning from Prose.

PUB DATE Mar 70

NOTE 18p.

EDRS PRICE EDRS Price MF-$0.25 HC-$1.00

DESCRIPTORS *Deductive Methods, *Inductive Methods, *Learning, *Transfer of Training

ABSTRACT

To determine the effects of several types of prior training in learning to identify instances of subject matter concepts and to assess the transfer effects of prior learning of strategy and content on learning from prose, 132 college sophomores inductively or deductively learned to identify schematic examples of abnormal EKG wave patterns after receiving one or combination of 1) practice at classifying geometric forms with or without using a focus scanning strategy; or 2) specific training on identifying and labeling component attributes of the concept "EKG wave." After attaining criterion on original learning (OL) with the schematics, Ss were given a transfer test on actual EKG tracings. All Ss then read and were tested on a 300-word prose passage. Simple and multiple inferential statistical comparisons of the mean scores on OL and transfer tests for eleven treatment and control groups revealed that deductive learning was superior to inductive in OL and transfer tests; training on identifying attributes improved performance on transfer tests but not on OL; receiving practice in classifying, with and without strategy, did not significantly improve performance. Results suggest that teaching selecticn strategies does not readily improve performance on complex classitication tasks; deductive approaches to learning concepts are more efficient in original learning and in transfer; prior training on the elements of a concept is a potent variable effective in facilitation transfer. (Author/JS)

The Effects of Classification Practice Selection Strategy and Attribute Labeling in Initial Concept Identification and Subsequent Learning from Prose

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Research on the facilitating effects of prior learning on present performance can be divided into two separate and fairly distinct categories. The first of these categories is exemplified by the research of Gagne' and his associates (Gagne', 1965) and can be described as research on content specific transfer where facilitation is presumed to be the effect of prior learning of specific content which is prerequisite or subordinate to the content of the transfer task. The second category of research on transfer of learning is exemplified by the work of Bruner, Goodnow, and Austin (1956) and is described as research on content non-specific transfer where facilitation is presumed to be the effect of acquiring a general learning strategy or style.

Not surprisingly, the work on content specific transfer has grown out of research on subject matter learning where the elaborate structure of relationships among concepts and principles within the subject matter becomes an important variable in investigation of learning efficiency (Caroll, 1964, and Suppes, 1966). Research on learning strategies and styles on the other hand, emanates from laboratories of experimental psychology where specific subject learning is usually of less concern. Research on both content specific and content non-specific transfer of learning are distinct from research on transfer which is presumed to be the effect of specific or general learning abilities (for example, Jensen, 1965) in that the implication of the first two is that the basis for transfer is educable while in the case of research on learning abilities, the same implication is not clear.

Educational psychologists have attempted to organize the findings of research on transfer of learning into a coherent set of recommendations for teachers who are attempting to arrange optimum conditions for learning in their classrooms (see, for example, DeCecco, 1968). The resulting prescriptions usually include recommendations for utilizing both content specific and content non-specific transfer. While such recommendations are logically derivable from existing research, the lack of empirical data on the learning of complex subject matter concepts makes most of these recommendations speculative (Caroll, 1964).

The present study was designed to determine the effects of both content specific and content non-specific transfer variables in initial concept learning and subsequent learning from prose. More precisely, the research was designed to answer the following questions:

1) Does practice at classifying or learning a strategy, add to the transfer effects of learning prerequisite content when learning to identify examples of a veridical concept?

2) Does training on identifying and labeling the attributes of a veridical concept improve performance on identifying examples of that concept?

3) Does prerequisite concept learning improve subsequent prose learning involving those concepts?

In an effort to shed some light on the continuing debate over the relative effectiveness of inductive and deductive approaches to learning (Guthrie, 1967) the research reported here was also designed to answer the following additional questions:

4) Does learning the definition of a veridical concept improve performance on learning to classify examples of that concept?

5) Does having a definition of a veridical concept prior to learning to classify examples of that concept improve performance on subsequent prose learning involving that concept?

METHOD

Subjects

One hundred thirty two male and female students from a Sophomore level education class at the University of Delaware participated as subjects (Ss) in the present experiment. Each S participated individually and was given credit toward his class grade for his participation. Each S was randomly assigned to one of seven treatment groups.

Design

Table 1 illustrates the design of the present study, specifies the sequence of training, and the number of subjects for each of the seven treatment groups. It can be seen that for each step in the training

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Insert Table 1 about here
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sequence a control group is included as a comparison group for the learning data which is obtained at Steps 4, 5, and 7 in the sequence.

Procedures

The training sequence for Group I is described here since all of the treatment conditions and the transfer comparisons are based upon the training sequence for Group I.

As each S entered the experimental room, he was given an explanation of the purpose of the experiment and a set of printed instructions regarding electrocardiogram (EKG) tracings, the names of the concepts to be learned--ischaemia, infarction, and injury, and a three by five card with each of these concept names printed upon it.

In Step 1 Ss were taught a conservative focusing strategy for identifying concepts. To ensure that the subjects learned the conservative focusing strategy, classification practice was given and each S was required to describe aloud just what attribute he was varying with each new card selection.

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In Step 2 Ss then learned to classify stimulus forms of the type used by Bruner in the work on strategy learning. These stimulus forms were presented in a 36-item array (6 x 6). Each S was given an example card and instructed to determine the general concept of which the card was an example. Ss continued to select examples until he could verbally define the concept correctly (selection paradigm). Each subject continued the classification task until he achieved correct definitions for three different concepts.

Step 3 consisted of training Ss to identify and label the elements of a normal EKG wave pattern. Each S was presented with an instruction sheet describing the nature of a normal EKG wave with labels for its critical points, and two pictures of normal EKG patterns--one hand drawn and the other a photo copy of an actual EKG wave. S was requested to study the material which was given to him and was permitted to study that material until she signaled that the material had been learned. The instruction sheet and the two pictures of the normal EKG patterns were then removed from sight, and S was asked to draw and label the critical parts of a normal EKG pattern. Ss failing to complete the drawing correctly were given an opportunity to review and to draw the pattern again until a perfect drawing was achieved.

In Step 4 of the study Ss learned to identify (that is classify) examples of the concepts ischaemia, infarction, and injury. At this point, the group was randomly subdivided into two groups. One of the subgroups learned to classify the concepts inductively (that is, without explanation or description of the characteristics of the concept). The other half of the group learned to classify the concepts deductively (that is, descriptions and explanations of the characterisitics of each of the concepts was given at the outset of classification training). In this portion of the experiment a 36-card array of schematic abnormal EKG patterns was used in a selection paradigm. A second 36-card array containing abnormal EKG patterns was available for use if subjects failed to reach a criterion of five correct examples in succession on the first array.

Step 5 of the study consisted of transfer test in which a series of 30 photocopies of actual EKG tracings was presented to the subjects in a reception paradigm and the number of correct classifications of the 30 tracings was recorded. Ss were not given feedback as to the correctness of their responses on the transfer test.

Step 6 consisted of a study session. Ss studied a two-page prose passage describing the three concepts which they had already learned, some relations among the concepts, and several of the implications of those concepts for medicine. A maximum of ten minutes was allowed to study the prose passages.

In Step 7 each S was given a 15-question multiple choice test on the content of the prose passage. Five of the multiple choice questions consisted of reading schematics of EKG wave abnormalities. These five items involved the greatest amount of transfer.

Results and Discussion

The results are presented and discussed in terms of the five questions posed in the introduction.

"Does practice at classifying, or learning a strategy, add to the transfer effects of learning prerequistic content when learning to identify examples of a veridical concept?" (Question #1) The answer to this question is based upon the results of performance among groups 1, 2, 3, 4, and 5 on Step 4 (trials--to--criterion on EKG schematics) and Step 5 (number correct on 30 actual tracings). Group means and variances for performance on Step 3 are shown in Table 2. Analysis of the data obtained in Step 3 shows that for the

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Insert Table 2 about here
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comparisons of interest none of the groups differed reliably from one another (t ratios in every case are less than one). The results of the analysis indicates that not only did prior practice on classifying or learning a strategy not improve performance over learning prerequisite content, but also that learning prerequisite content (in the form of conceptual attributes) did not improve performance on initial learning to classify the schematic concepts. Said more simply, no form of prior training improved performance on learning to classify schematic examplars of the concept.

"Does training on identifying and labeling the attributes of a veridical concept improve performance on identifying examples of that concept?" (Question # 2) The analysis of the data obtained from Step 5 bearing on the same question give a different picture. Inspection of the mean performance for the groups presented in Table 3 represents clearly what the analyses reveal; that is, the Groups 1, 2, and 3 do not differ significantly from one another.

Insert Table 3 about here

A comparison of the performance of Group 3 versus that of Group 4 and comparison of Group 4 versus the performance of Group 5 shows that in both cases the mean scores are reliably different ($t = 2.8$, $P < .005$, and $t = 5.4$, $P < .0005$, respectively). The comparison between Groups 4 and 5 reveals that prior experience on classifying schematics improved subsequent performance on classifying actual EKG tracings. The comparison between Groups 3 and 4, is especially interesting in that these two groups performed equally on the immediately preceeding Step involving learning to classify the schematics. Groups 3 and 4 differ on the basis of whether their prior experience included learning to identify the elements of the EKG wave. The analysis shows that although learning to identify the attributes of an EKG wave did not necessarily improve immediate classification performance on the schematics, it did improve performance on subsequent transfer to actual EKG tracing. It may be that prior training on prerequisite content does not necessarily effect improvement on a task where direct practice can be, and is, given but it may improve performance on subsequent tasks where the transfer is greater.

"Does learning the definition of a veridical improve performance on learning to classify examples of that concept?" (Question # 4) Statistical analysis of the data on Steps 4 and 5 obtained from the inductive and the deductive groups reveals a consistent difference between these two groups in favor of deductive training. Table 3 presents the mean performances for each subdivided group on the transfer test with actual EKG tracings. Table 4 presents the summary analysis of variance table for the data upon which the group means presented in Table 3 are based. (Group 5, the learning control group is not included since its training did not involve deductive and inductive training).

Insert Table 4 about here

Analysis of the trials-to-criterion data from Step 4 for the same groups yields the same clear superiority for the deductive learning group ($F =$ 10.2, df.1, 88 $P < .005$). The results of these comparisons lend strong support to the nation that learning to classify examples of a veridical concept proceeds most rapidly when a clear exposition of conceptual attributes is supplied.

Answer to the remaining questions are based upon data obtained in Step 7 of the training sequence (a multiple choice test on the prose passage).

"Does prerequisite concept learning improve subsequent prose learning involving those concepts?" (Question # 3) Table 5 contains the mean number correct on the final test for all experimental groups summed over Induction and Deduction. Table 6 contains the summary of the results of statistical

Insert Table 5 about here

comparisons among the treatment groups which are of primary interest. It is evident from Table 6 that those groups having an opportunity to learn

Insert Table 6 about here

the attributes of a concept prior to learning to classify instances of the schematics (Groups 1, 2, and 3) performed better on the final test than did the group which only classified instances of the schematics without prior learning of the attributes (Group 4). This finding is consistent with the earlier finding where prerequisite learning of the attributes improved performance on subsequent tests of performance on reading actual EKG tracings.

It is worthy of note that on the final test, Group 4 which had learned to classify to criterion on the EKG schematics still did not perform better than Groups 5 and 6 which could not profit from prior learning. In the present study, at least, one would have done as well simply by studying the prose passage, and not having learned to classify examples of the concept. Learning to classify conceptual instances without labeling the attributes appears to be of little transfer value in subsequent prose learning. This consistent facilitation of subsequent performance as a result of prerequisite learning of conceptual attributes emphasizes the potential value of content specific tranfer for subject matter learning.

"Does having a definition of a veridical concept prior to learning to classify examples of that concept result in improved performance on subsequent prose learning involving the concept?" (Question # 5) The mean performance on the final task for the inductive-deductive learning groups is presented in Table 7. A summary of the analysis of variance on the

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Insert Table 7 about here
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data obtained from from those groups is presented in Table 8. Although all

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Insert Table 8 about here
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sources of variation were statistically significant only the inductive-deductive source and the interaction source need be considered here since the significant F ratio for Prior Training is merely a confirmation of the analysis already presented more completely in Table 6.

As in the results of the analysis of performance on reading actual EKG tracings, the deductive learning groups generally performed better on the final test, than did the inductive learning groups. This finding must be somewhat qualified, however, since a significant interaction was obtained as a result of the better performance by the inductive learners in group one. More careful analysis of the test performance revealed that the better performance by inductive learners in Group 1 was primarily attributable to a disproportionately greater number of the factual items being answered correctly by this group (that is, those items which did not require reading of EKG tracings). It is difficult to develop a sensible explanation for this inconsistency. The fact that Group 1 performance on all other analyses was consistent with Groups 2 and 3 makes it likely that the obtained significant interaction was spurious.

In sum, the results of the present study suggest the following conclusions:

1) Classification practice and learning a selection strategy does not readily produce significant improvement in learning complex subject matter concepts.

2) Prior training on the elements (learning to identify and label attributes) of a subject matter concept is a potent variable influencing subsequent performance on transfer tasks involving those concepts.

3) Deductive training is more efficient when learning to identify conceptual instances and contributes to improved performance on subsequent prose learning involving those concepts.

4) Direct practice on classifying instances of a subject matter concept improves performance on the practice instances but seems to have little transfer value.

The conclusions from the present study would seem to suggest that educational practitioners might profitably arrange curricula by programming for content specific transfer and deductive learning when possible.

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Table 1

Classification of the treatment groups in terms of the training sequence

	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7
Step 1 Learn Classification Strategy	(24) X						
Step 2 Classify Geometric Forms	X	(24) X					
Step 3 Identify and Label Attributes	X	X	(24) X				
Step 4 Classify EKG Schematics	(12) X_I[b] (12) X_D[c]	(12) X_I (12) X_D	(12) X_I (12) X_D	(12) X_I (12) X_D			
Step 5 Test on EKG Photocopies	X	X	X	X	(12) X		
Step 6 Study Prose Passage	X	X	X	X	X	(12) X	
Step 7 Multiple Choice Test on Prose Passage	X	X	X	X	X	X	(12) X

a Numerals in parentheses reprent number of subjects in group
b I indicates inductive learning
c D indicates deductive learning

Table 2

Group Means and Variances on Step 4

	Trials-to-Criterion on Schematics	
	$\overline{X}$	s^2
Group 1	20.1	20.7
Group 2	19.7	21.9
Group 3	18.8	22.3
Group 4	20.3	
Group 5	______	______

Table 3

Mean Performance of Groups on Step 5
(Identifying Actual EKG Tracings)

Groups

	1	2	3	4	5
Induction	19.8	18.9	20.4	17.3	
Deduction	22.9	24.5	23.3	21.1	13.9
Totals	21.3	21.3	21.3	19.2	

Table 4

Analysis of Variance Table
for Inductive-Deductive Groups
on Actual EKG Tracings

Source of Variation	df	Sums of Squares	Mean Squares	F	P value
Prior Training	3	110.67	36.89	4.03	$<.025$
Induction-Deduction	1	352.83	352.83	38.54	$<.0005$
Prior Traning X Induction-Deduction	3	26.84	8.95	0.98	$<.50$
Error	88	805.70	9.2		

Table 5

Mean Number Correct on Final
Test for All Experimental Groups
(Summed across Induction-Deduction)

	Group 1	2	3	4	5	6	7
$\overline{X}$	12.2	11.5	11.9	9.9	8.6	10.3	5.6
s_2	2.3	4.6	2.4	2.9	1.7	2.5	1.7

Table 6

Summary Table of t ratio and
P value for Comparisons of Interest

h	Comparisons	t ratio	P value
1	Learning attributes and classfying schematics (Groups 1,2,3,4 vs. 5,6)	4.97	<.005
2	Learning attributes (Groups 1,2,3, vs. 4)	3.69	<.005
3	Classifying schematics (Group 4 vs. 5, 6)	0.91	<.50
4	Studying passage (Groups 5, 6, vs. 7)	7.66	<.005

Table 7

Mean Number Correct on Final Test for Inductive-Deductive Learning Groups

	1	2	3	4
Induction	12.7	10.4	11.6	9.1
Deduction	11.8	12.6	12.3	10.7

Table 8

Analysis of Variance Table
for Inductive-Deductive Groups
on Final Test

Source of Variation	df	Sum of Squares	Mean Square	F	P value
Prior Training	3	77.25	25.75	9.53	<.0005
Induction Deduction	1	24.00	24.00	8.88	<.0005
Prior Training X Induction-Deduction	3	29.42	9.81	3.63	<.05
Error	88	237.83	2.70		